HR-327 Evaluation of the Chemical Durability of Iowa Fly Ash Concretes

Key Words: Fly Ash, Concrete, PCC, Concret Durability, Chemical Durability

ABSTRACT

The major objective of this research project was to investigate how Iowa fly ashes influenced the chemical durability of portland cement based materials. Chemical durability has become an area of uncertainty because of the winter application of deicer salts (rock salts) that contain a significant amount of sulfate impurities.

The sulfate durability testing program consisted of monitoring portland cement-fly ash paste, mortar and concrete test specimens that had been subjected to aqueous solutions containing various concentrations of salts (both sulfate and chloride). The paste and mortar specimens were monitored for length as a function of time. The concrete test specimens were monitored for length, relative dynamic modulus and mass as a function of time.

The alkali-aggregate reactivity testing program consisted of monitoring the expansion of ASTM C311 mortar bar specimens that contained three different aggregates (Pyrex glass, Oreapolis and standard Ottawa sand).

The results of the sulfate durability study indicated that the paste and concrete test specimens tended to exhibit surface spalling but only very slow expansive tendencies. This suggested that the permeability of the test specimens was controlling the rate of deterioration. Concrete specimens are still being monitored because the majority of the test specimens have expanded less than 0.05 percent; hence, this makes it difficult to estimate the service life of the concrete test specimens or to quantify the performance of the different fly ashes that were used in the study. The results of the mortar bar studies indicated that the chemical composition of the various fly ashes did have an influence on their sulfate resistance. Typically, Clinton and Louisa fly ashes performed the best, followed by the Ottumwa, Neal 4 and then Council Bluffs fly ashes. Council Bluffs fly ash was the only fly ash that consistently reduced the sulfate resistance of the many different mortar specimens that were investigated during this study. None of the trends that were observed in the mortar bar studies have yet become evident in the concrete phase of this project.

The results of the alkali aggregate study indicated that the Oreapolis aggregate is not very sensitive to

alkali attack. Two of the fly ashes, Council Bluffs and Ottumwa, tended to increase the expansion of mortar bar specimens that contained the Oreapolis aggregate. However, it was not clear if the additional expansion was due to the alkali content of the fly ash, the periclase content of the fly ash or the cristobalite content of the fly ash, since all three of these factors have been found to influence the test results.